ASPIDOSAURUS BINASSER (AMPHIBIA, TEMNOSPONDYLI), A NEW SPECIES OF DISSOROPHIDAE FROM THE LOWER PERMIAN OF TEXAS

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ABSTRACT

A new species of the dissorophid amphibian *Aspidosaurus*, *A. binasser*, is based on a single specimen consisting of the greater part of the skull and short, articulated strings of vertebrae, as well as numerous isolated and fragmentary vertebrae, from the presacral and caudal regions of the column collected from the Lower Permian (Leonardian) Arroyo Formation, Clear Fork Group, Baylor County, Texas. Comparisons with the holotype and only known specimen of the type species, *A. chiton* Broili, 1904, also from the Arroyo Formation in Texas and consisting not only of small portions of the vertebral column, but the only previously known skull of the genus, is unfortunately limited because it was lost during World War II. Although numerous characters of the skulls of *A. binasser* and *A. chiton* clearly document a dissorophid assignment, only one unique character is recognized that both share among the dissorophids, a relatively long preorbital skull length. The skull of *A. binasser* possesses a number of unique characters, as well as a combination of characters, that distinguish it from other dissorophids. These offer a better understanding of *Aspidosaurus* that dispels speculation of a closer relationship with *Platyhystrix* than with any other dissorophid.

Although the armored neural spines of *A. binasser* are *Aspidosaurus*-like in their fundamental structural plan, they exhibit a wide range of morphologies heretofore unknown in the genus, including two variants that distinguish it from *A. chiton* and the only other described species of *Aspidosaurus*, *A. glascocki* Case, (1910), *A. apicalis* (Cope, 1878), and *A. crucifer* (Case, 1903). The latter are regarded here as *nomina dubia*, as their holotypes, consisting of very small, isolated portions of the vertebral column from the Lower Permian of Texas and New Mexico, are considered insufficient for species identification.

KEY WORDS: Dissorophidae (*Aspidosaurus*), Temnospondyli, vertebral armor, Lower Permian, Texas

INTRODUCTION

Since its first use, the constitution of Dissorophidae Boulenger, 1902, has received numerous revisions. The early history of these revisions has been chronicled by DeMar (1966) in a detailed review of the early taxonomic history and relationships of the group. Recent phylogenetic studies (Boy, 1972; Dilkes, 1990; Daly, 1994) have tended to restrict Dissorophidae to its highly terrestrial genera, almost all of which are known to possess the specialization of well-developed, sculptured, dermal armor segments closely associated with the neural spines of the vertebral column. Unarmored genera, such as *Amphibamus*, *Doleserpeton*, and *Tersomius*, originally included in Dissorophidae, have been reassigned (Daly, 1994; Boy, 1972) to Amphibamidae (erected by Boy, 1972, solely for *Amphibamus*), although remaining united with Dissorophidae under Dissorophoidea. Daly (1994) proposed a further breakup of the Dissorophidae, viewing the somewhat aberrant *Platyhystrix*, *Astreptorhachis*, and *Ecolsonia* as deserving of separate family status, despite being considered dissorophids by most authors (Vaughn, 1971; Berman et al., 1981, 1985), uniting the first two in the new family Platyhystricidae, while judging the family status of

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Ecolsonia as unresolved and best left as *incertae sedis*. With the exception of Daly's suggested classification, Dissorophidae represents one of the largest groups of Paleozoic temnospondyl amphibians, including about 16 genera, having a temporal and spatial range from the Late Pennsylvanian and Early Permian of the United States (Carroll, 1964; Vaughn, 1971; Berman and Berman, 1975; Berman et al., 1985) to the Late Permian of Russia (Eichwald, 1848; Gubin, 1980) and China (Li and Cheng, 1999). In addition, vertebrae described and referred to *Actinodon* by Gaudry (1879, 1883) from the Late Carboniferous of France were recognized by Romer (1947) as being of the aspidosaur type.

It is undoubtedly the conspicuous armor that most dramatically characterizes the Dissorophidae. In a detailed phylogenetic and functional analysis of the armor of dissorophids, DeMar (1966, 1968) concluded that it served several functions, all directly related to a highly terrestrial existence. Although primarily a means of strengthening and restricting movements of the vertebral column, secondary functions of the armor probably included reduction of water loss by evaporation through the skin and protection from predators. Most importantly, the armor has also been a major source of data for taxonomic and phylogenetic considerations of dissorophids (Carroll, 1964; DeMar, 1966, 1968; Bolt, 1974). DeMar's (1966, 1968) studies of dissorophid armor not only demonstrated a wide range in gross and detailed morphologies between most species, but the presence of distinct structural patterns that indicate the independent development of armor in at least two, possibly three, different lines during the Late Pennsylvanian or Early Permian.

One of the least understood of all the armored dissorophids is *Aspidosaurus*. Several circumstances account for this. The holotype and only known specimen of the type species, *A. chiton* Broili, 1904, consists of the greater portion of the skull and small portions of the armored vertebral column from a single site, Coffee Creek, in the Lower Permian Arroyo Formation of Texas. The skull and vertebrae were cataloged separately at the Museum of the Alte Akademie, Munich, as nos. 84 and 85, respectively, even though they were apparently regarded as belonging to a single individual. Unfortunately, the holotype was lost during World War II and therefore has not been available for recent comprehensive studies of Dissorophidae (Carroll, 1964; DeMar, 1966, 1968). Broili's (1904) description of the holotype, however, has remained sufficient to accept the validity of *A. chiton* and its dissorophid assignment. Undoubtedly, it has been in large part the character of the vertebrae, or more specifically the dermal armor capping the neural spines, that has had the greatest influence in the continued recognition of *A. chiton* as a dissorophid.

In general, the armor consists of small, coarsely sculptured, transversely narrow, roof-shaped pieces of dermal bone that are fused firmly to and slope ventrolaterally from the dorsal surface of the distally expanded neural spine and that may or may not overlap each other along their anterior and posterior margins (Carroll, 1964; DeMar, 1966). Although Broili's (1904) illustrations indicate two or three varieties of armored neural spines in *A. chiton*, his description and generalized reconstruction of two articulated presacral vertebrae with slightly overlapping armor segments apparently misled later workers (Case, 1911; DeMar, 1966) into believing that they characterize the entire column. As a further source of confusion, three additional species of *Aspidosaurus* have been described, all based on very small portions of the armored vertebral column from the Lower Permian of Texas and New Mexico: *A. glascocki* Case (1910), *A. apicalis* (Cope, 1878), and *A. crucifer* (Case, 1903). Whereas all three species assuredly belong to *Aspidosaurus*, the incompleteness of the holotypes and the very modest differences they exhibit between not only each other but with *A. chiton* as well, strongly suggests that only the latter is valid.

A recently discovered specimen of *Aspidosaurus* from the Lower Permian Arroyo Formation of Texas (Fig. 1) is described here as a new species. It consists of the greater part of the skull and short, articulated strings of vertebrae, as well as numerous isolated and
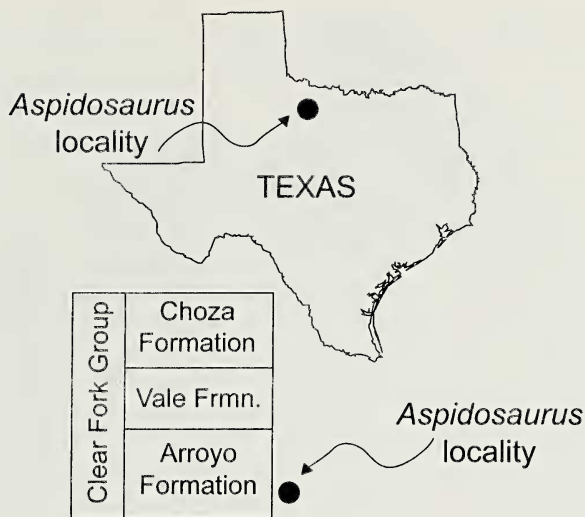
Fig. 1.—Locality map and generalized stratigraphic section of Lower Permian Clear Fork Group showing location of the holotype of *Aspidosaurus binasser*, TMM 43531-1.

fragmentary vertebrae, from the presacral and caudal regions. As far as can be determined from Broili's (1904) description, the skull appears to be identical to that of *A. chiton*, sharing with it not only several dissorophid characters, but also one that is unique among dissorophids, a relatively long preorbital region of the skull. Equally significant, although the armored neural spines of the new species are undeniably *Aspidosaurus*-like in their basic structural plan, they exhibit a range of morphologies heretofore not suspected in any of the previously described species of *Aspidosaurus*, including two variants that are unique.

The following acronyms are used to refer to institutional repositories of specimens: AMNH, American Museum of Natural History, New York, New York; CNMH, Chicago Natural History Museum, Illinois; MCZ, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts; TMM, Texas Memorial Museum, University of Texas, Austin.

Anatomical structures are identified by the following abbreviations: apf, anterior palatal fenestra; bo, basioccipital; ex, external naris; f, frontal; in, internal naris; inf, internarial fenestra; j, jugal; l, lacrimal; m, maxilla; n, nasal; oc, occipital condyle; p, parietal; pal, palatine; pf, postfrontal; pm, premaxilla; po, postorbital; pop, paroccipital process; pp, postparietal; prf, prefrontal; ps, parasphenoid; psp, postsplenial; pt, pterygoid; s, stapes; scp, sclerotic plates; sm, septomaxilla; sp, splenial; sq, squamosal; st, supratemporal; t, tabular; ts, tusk or tusk and socket pair.

SYSTEMATIC PALEONTOLOGY

Order Temnospondyli Zittel, 1888
Superfamily Dissorophoidea Bolt, 1969
Family Dissorophidae Boulenger, 1902
Genus *Aspidosaurus* Broili, 1904
Type species *Aspidosaurus chiton* Broili, 1904

Diagnosis.—Large dissorophid temnospondyl distinguished by the following unique cranial characters: 1) preorbital skull length 51 to 54% of the midline skull length and

significantly greater than the postorbital length; 2) maxilla and its dentition extend posteriorly to a level just posterior to the anterior margin of orbit; 3) nasal and lacrimal margins of external naris are beveled ventrally to a sharp edge that appears serrated due to the dorsal surface sculpturing; 4) frontals extend anteriorly to a level well beyond the orbits and equal to the anterior extent of the prefrontals; 5) jugal extends anteriorly to approximately the level of the anterior margin of the orbit; 6) presence of an anterior palatal fenestra. The following cranial features collectively distinguish *Aspidosaurus* from other dissorophids: 1) exposure of palatine on skull roof; 2) presence of an internarial fenestra or median rostral fontanel; 3) internal naris extremely long, with a length three times its width; 4) basipterygoid process of braincase and basal process of pterygoid firmly united suturally in an immobile basicranial articulation.

The armored neural spines (defined here as the endochondral vertebral neural spine plus the dermal bone segment or armor capping it) may vary widely in morphology but exhibit a single general structural pattern: each coarsely sculptured, small, transversely and longitudinally narrow, roof-shaped dermal bone segment or armor is firmly fused to the dorsal surface of the distally expanded neural spine so that roof halves slope ventrolaterally. The armored neural spines are not partially overlapped by a second, more superficial set of segmental plates of dermal bone.

Remarks.—Although Broili's (1904) emphasis on the description of the axial skeleton in *A. chiton* provides a strong basis for identification, his description of the skull offered little more than the establishment of its dissorophid affinities. The holotypes of the only other known species of *Aspidosaurus*, *A. glascocki*, *A. apicalis*, and *A. crucifer*, are based on fragmentary postcranial specimens consisting mainly or solely of vertebrae with fused dermal armor and are here considered insufficient to permit specific identification and, thus, are regarded as *nomina dubia*. Therefore, inasmuch as the only known differences between the holotypes of *A. binasser* (TMM 43531-1) and the type species are restricted to the postcranium, cranial features of the former are used in the generic diagnosis, which is intended as a guide for comparisons with the future discoveries, with the expectation that amendments will be necessary.

Aspidosaurus binasser, new species

Holotype.—TMM 43531-1, greater portion of skull, preserved in several major pieces, and several short strings of from two to five articulated vertebrae and numerous isolated and fragmentary vertebrae from the presacral and caudal regions. There is no reason to suspect more than one individual is represented. A considerable amount of appendicular material was, however, collected along with the holotype, some too fragmentary to identify but most evidently pertaining to a pelycosaurian-grade synapsid.

Horizon and Locality.—TMM 43531-1 was collected by Mark Rowland in strata of the lower part of the Lower Permian Clear Fork Group on the north shore of Lake Kemp in Baylor County, Texas (approximately at 33°47.91′ north latitude, and 99°11.34′ west longitude) (Fig. 1). This locality is near the base of the Clear Fork Group, stratigraphically well below marker sandstone 4 of Hentz and Brown (1987), and approximately at the level of the "Craddock dolomite" Nelson et al. (2001), so it is in strata equivalent to the Leonardian Arroyo Formation (Hentz, 1988; Nelson et al., 2001).

Diagnosis.—Neural spines of probable presacral and anterior caudal vertebrae with prominent bilaterally paired tubercles, and neural spine and its sculptured dermal armor of probable anterior caudal vertebrae extremely compressed laterally in the form of a thin, spatulate structure.

Etymology.—Derived from the Latin *binus*, meaning two by two, couple, or pair, and *asser*, meaning beam or pole, referring to the prominent pair of bilateral tubercles on most of the neural spines of the presacral and anterior caudal vertebrae.
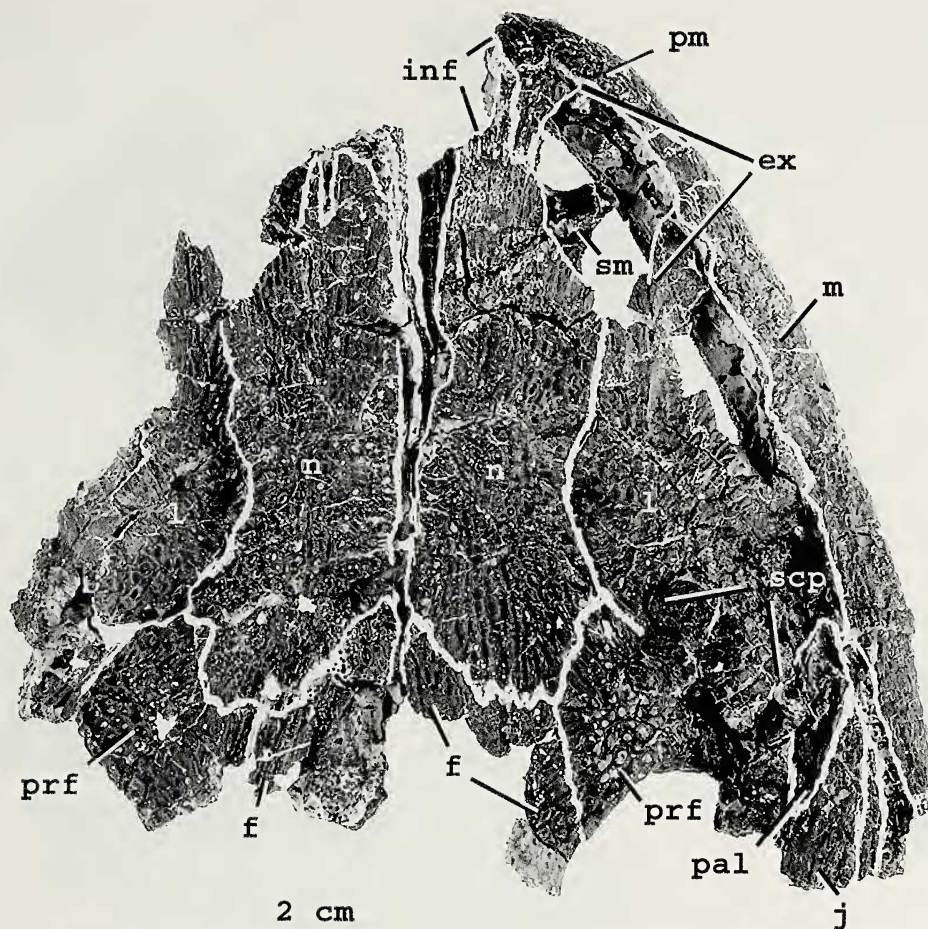
Fig. 2.—*Aspidosaurus binasser*, holotype, TMM 43531-1. Preorbital portion of skull in dorsal view.

DESCRIPTION

Skull and Lower Jaw.—The main, preserved portions of the skull include: 1) anterior portion of the skull, including the roof and palate, extending from a level at about the mid-length of the orbits (Figs. 2 and 3). Within this portion most of the losses to the skull roof and palate are areas marginal to the maxillae; 2) a disarticulated left premaxilla (Fig. 4A–C); 3) a narrow strip of the right side of the skull roof that extends from the orbit and borders the dorsal margin of the otic notch to end close to the distal end of the posterolateral, horn-like extension of the skull table and includes portions of the postfrontal, postorbital, squamosal, supratemportal, and tabular (Fig. 4D); 4) an essentially complete braincase with a partial left stapes and fragments of the overlying parietal, postparietal, and supratemporal (Fig. 5); and 5) the anterior portions of both mandibles, with the right being the most complete and including elements anterior to the adductor fossa.

The skull of *Aspidosaurus binasser* (TMM 14151-1) is unmistakeningly dissorophid in structure, but does exhibit numerous features that easily distinguish it from other members of the group. The preserved, anterior portion of the skull (Figs. 2 and 3) indicates a broadly rounded snout. This portion of the skull and those including the dorsal rim of the otic notch
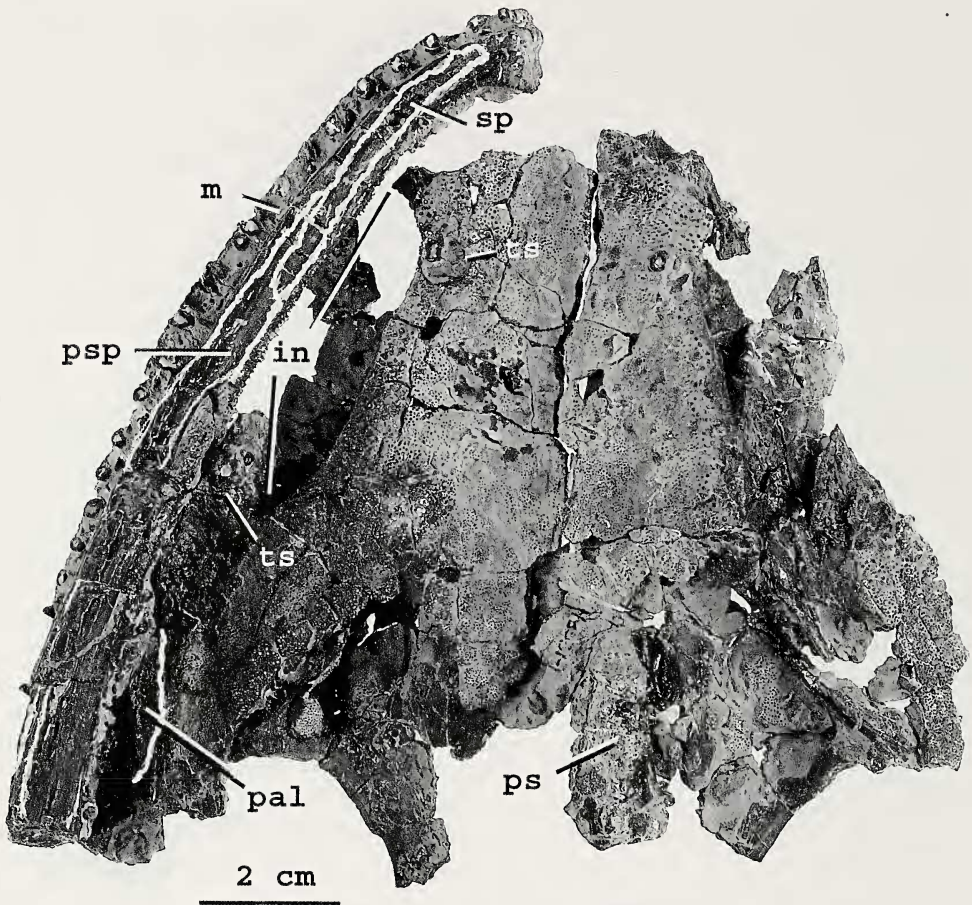
Fig. 3.—*Aspidosaurus binasser*, holotype, TMM 43531-1. Preorbital portion of skull in ventral view.

(Fig. 4D) and posterior margin of the skull table preserved with the braincase (Fig. 5) allow for fairly accurate estimates of the following pertinent skulls measurements: total length along the midline, 19.5 cm; preorbital length, 10.5 cm; postorbital length along the midline, 5.0 cm, and to the level of distal end of tabular, 7.0 cm; minimum interorbital width, 3.8 cm; longitudinal and transverse diameters of orbit, 3.0 cm. These measurements indicate a preorbital length that is nearly 54% of the midline skull length and significantly greater than the postorbital length. The pattern of the dermal sculpturing of the skull roof is typical of moderate- to large-sized dissorophids, consisting of a reticulate network of ridges surrounding deep pits or short furrows. Its greatest development is along the lateral and posterior margins of the skull table and the orbital margins, where deep, circular pits predominate, whereas its least developed is in the central, preorbital area, where a general pattern of short, shallower furrows radiate from a central area. The prefrontal and postorbital are greatly thickened into broadly rounded, anteroposteriorly oriented, ridge-like swellings that become broader and thicker toward the orbital rim.

Both premaxillae are present. The isolated left premaxilla (Fig. 5) lacks the dorsal process, whereas the right is complete, but not fully exposed, and articulated with the skull roof and forms the anterior and anterolateral margins of the external naris. Its narrow,
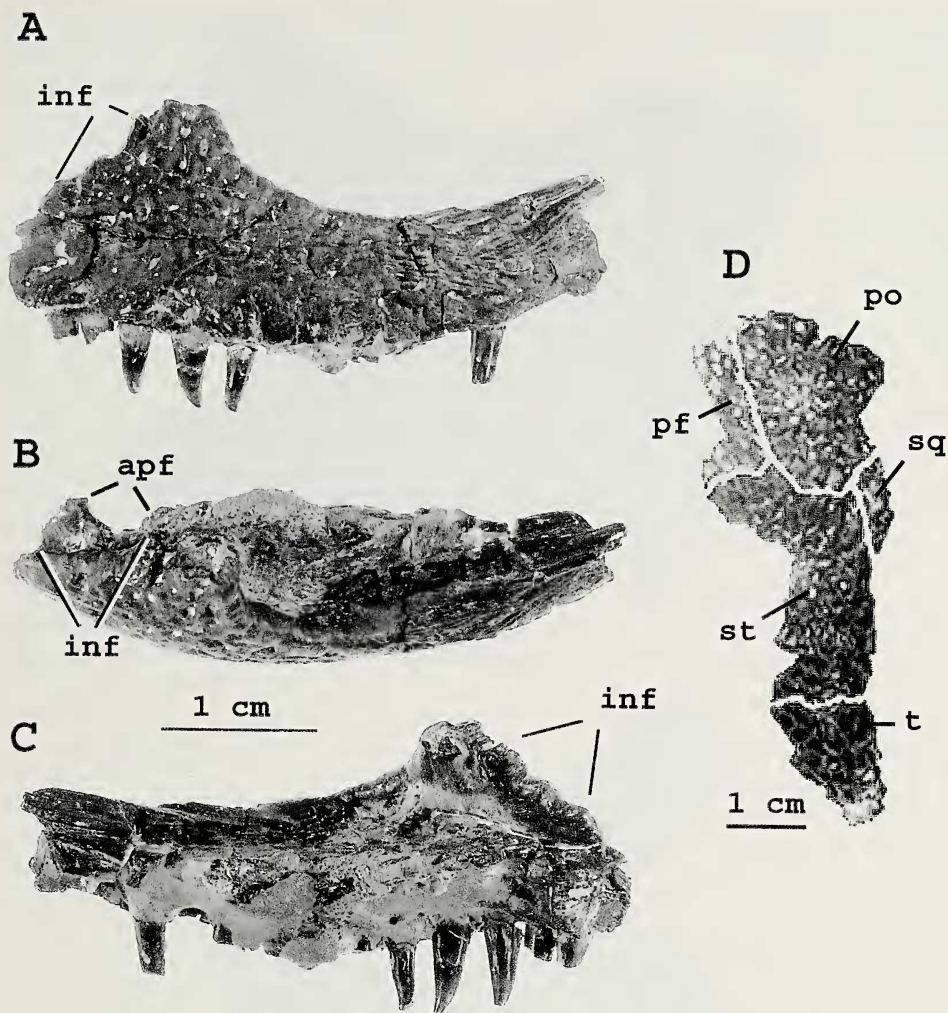
Fig. 4.—*Aspidosaurus binasser*, holotype, TMM 43531-1. Left premaxilla in A, lateral, B, dorsal, and C, medial views. D, Narrow strip of right side of the skull-roof table that extends from the orbital margin of the postorbital to nearly the distal end of the posterolateral, horn-like extension of the tabular.

rectangular, posterodorsal process projects into the anterior end of the nasal very near its narial margin. A narrow palatal shelf projects medially from about the level of the dorsal surface of the alveolar shelf. At the anterior end of the lateral margin of the shelf is a small, semicircular notch of unknown function that likely united with a similar notch on the lateral margin of the vomer. Each premaxilla possessed 13 teeth or alveoli, but only the left premaxilla retains a few complete teeth. They are sharply pointed cones with the distal ends curving slightly posteromedially. There appears to be a slight decrease in tooth size posteriorly from a basal diameter of about 4 mm and a length of about 10 mm to about 3 and 9 mm, respectively. There is no indication of "caniniform" teeth. Both nasals are essentially complete and have a narrow, rectangular outline in which the width equals about one-third the length. At the intersection of the paired premaxillae and nasals
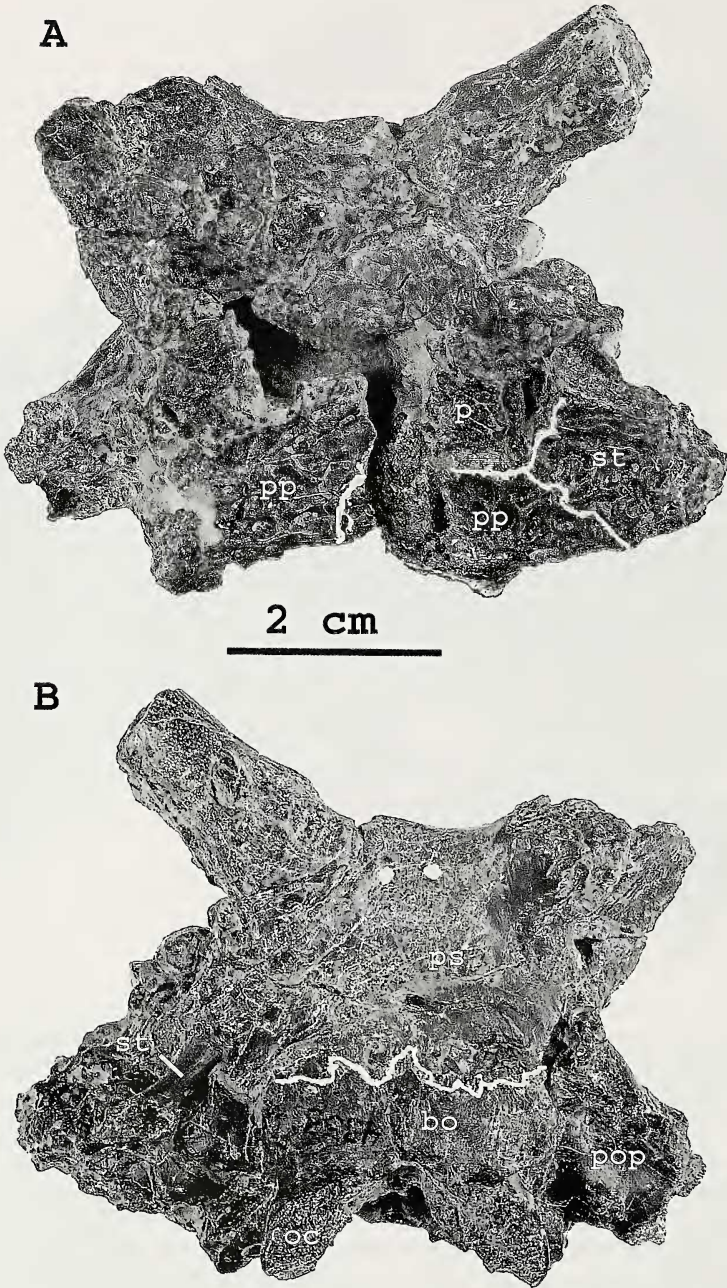
Fig. 5.—*Aspidosaurus binasser*, holotype, TMM 43531-1. Braincase in A, dorsal view with remnants of dorsal covering of dermal bones, and B, ventral view.

is a longitudinally elongate, elliptical opening, which has been referred to as either the median rostral fontanel or the internarial fenestra (Carroll, 1964; Dilkes, 1993). The more complete right nasal indicates that the anterior third of its lateral margin formed the medial margin of the external naris. Breaks have freed the anterior third of the right nasal, revealing

that its ventral surface lacks any sign of a nasal flange, which in trematopids projects ventrally from the internal surfaces of mainly the nasal and prefrontal (Dilkes, 1993). Only the anterior ends of the frontals are preserved. Their anterior margins converge on the midline to penetrate moderately between the nasals to a level well anterior of the orbits and equal to the anterior extent of the prefrontals. The right frontal indicates it had a substantial contribution to the orbital rim.

The more complete right lacrimal, lacking only minor amounts of its lateral margin, indicates a large element that is subequal in length to the nasal. Although its precise margins are not traceable, it undoubtedly had an outline of an elongated diamond, with a greatest width at its midlength, and extended from a narrow contribution to the anterior margin of the orbit to its formation of the posterolateral margin of the external naris. Of the narrow strip of the skull roof that extends from the orbit to nearly the distal end of the posterolateral, horn-like extension of the skull table and includes the postfrontal, postorbital, squamosal, supratemporal, and tabular (Fig. 4A–C), only the postorbital is nearly complete. Importantly, the elements of this strip of bone exhibit a sutural pattern and define the dorsal margin of a deep otic notch with a slight downturning posteriorly that are characteristic of dissorophoids. Unfortunately, their contribution to the narrow band of smooth bone marginal to the dorsal rim of the otic notch, the supratympanic flange, is nearly completely lost.

Only the right maxilla is essentially complete and preserved articulated with the anterior portion of the skull. Its moderate contribution to the central area of the lateral narial rim is well defined, but much of its mid-length contact with the lacrimal is only intermittently traceable due to the loss of bone. Posteriorly the maxilla, including its dentition, extends to a level just beyond the anterior margin of the orbit. Here it is widely separated from the orbital margin by its contacts with the anterior ends of first a probable, dorsal exposure of the palatine and then the jugal. The right maxilla possesses 33 teeth, or rather mostly their bases or alveoli, as only two teeth are nearly complete, and they are identical to those of the premaxilla. Anteriorly the teeth are equal in size to the largest of those of the premaxilla, judging from their basal diameter, and exhibit only a small, general decrease in size at the posterior end of the series. There is no indication of anterior "caniniform" teeth. A sculptured element with a narrowly diamond-shaped outline extends a short distance anteriorly from the anteroventral margin of the orbit and is interposed between the lacrimal medially and the jugal and maxilla laterally, and it is tentatively identified as a dorsal exposure of the palatine. The jugal is represented only by the anterior end of the right element. It obviously formed nearly the entire ventral rim of the orbit before wedging between the distal ends of the probable palatine and maxilla.

Only the right external naris is completely defined by its marginal elements. It is unusually large, with a broad, anteroposteriorly elongate oval outline. The edges of the medial and posterior narial borders formed by the nasal and lacrimal are unusual in being beveled ventrally to form a sharp edge that appears slightly serrated due to the dorsal surface sculpturing. The anterior half of the external naris is floored partially by the incomplete vomer, whereas the posterior half opens over the anterior third of the internal naris. Lying on the dorsal surface of the vomer at the anterior margin of the internal naris is an incompletely preserved septomaxilla. In its preserved position it would have divided the external naris subequally. There is no triangular, lateral projection of the narial margin of the nasal or a slight dorsal elevation of the narial margin of the maxilla that would have partially subdivided the external naris opening into two distinct portions, as in the dissorophid *Ecolsonia* (Berman et al., 1985) and trematopids (Dilkes, 1990, 1993). Although the postparietal and tabular bones overlying the braincase are incomplete, they indicate the absence of a prominent, sculptured ridge along their occipital margin. However, both elements possess portions of a narrow, smooth occipital flange.

A string of about ten, variously complete, partially overlapping, narrowly rectangular, well-ossified plates, extending from just inside the right orbit and across the posterior end of the lacrimal, undoubtedly represents a sclerotic ring. Although the possession of this structure is not unexpected in the armored dissorophids, its presence in *Aspidosaurus binasser* may represent the only irrefutable example for the group. Carroll (1964) figured a faint ring of plates in a specimen he referred to *Conjunctio*, but A. R. Milner (personal communication) reports being unable to confirm the presence of this structure in his examination of the specimen.

Although much of the palate remains, the sutures are not traceable, except for possibly that separating the right ectopterygoid and pterygoid. This is due to an expansive, dense, coarse shagreen covering of denticles that attain a maximum basal diameter of about 1 mm, particularly along the medial margin of the internal naris, and an indurate, limy, matrix surrounding their bases that cannot be removed without damage to the specimen. The internal naris is extraordinarily long, with a length equal to about three times its width. Its medial margin is greatly thickened into a dorsally curving, low, lip-like structure. Although the margins of the interpterygoid vacuities are incomplete, it is obvious that these openings were greatly expanded to the same extent as seen in other dissorophids, such as *Dissorophus*, *Broiliellus*, and *Ecolsonia* (Carroll, 1964; DeMar, 1968; Berman et al., 1985). In *Aspidosaurus binasser*, however, the vacuities appear less extensive anteriorly than in other dissorophids. This is a perception due to a lengthening of the palatal area anterior to the vacuities, including the internal nares, that reflects the unique feature in *Aspidosaurus* among dissorophids of a proportionally longer preorbital region of the skull (see "Comparisons and Discussion" section below). Scattered throughout the area of the interpterygoid vacuities are thin, irregular, denticulated plates. They are interpreted as having once formed a continuous, ossified, denticulated "skin" covering of the interpterygoid vacuity region of the palate. An identical structure was reported (Berman and Berman, 1975) in the dissorophid *Broiliellus hektotopos*, whereas an ossified "skin" membrane covering the entire palate was described (Carroll, 1964) in the amphibamid *Amphibamus lyelli*.

The anterior portions of the vomers are incomplete, but at the anteromedial margin of the right internal naris, which almost certainly was formed by the vomer, is a very large, circular alveolus that is about two-thirds occupied by the base of a large tooth and a socket. A large tooth is also present at the posteromedial margin of the internal naris that was undoubtedly borne by the palatine.

Braincase.—The nearly complete braincase of *Aspidosaurus binasser* (Fig. 5) exhibits moderate dorsoventral crushing and numerous fractures, but is well enough preserved to describe its general features and to recognize a few obvious differences from those of some medium- to large-sized dissorophids. Although all that remains of the parasphenoidal rostrum or cultriform process is a small portion (a little over 3 cm long) near its distal end, it is distinct from the thin, vertical, blade-like structure described in some dissorophids (Carroll, 1964; DeMar, 1968; Berman et al., 1981, 1985). In cross-section it has the general appearance of a stoutly constructed I-beam in which a short, stout vertical pillar separates narrowly two horizontal bars: a broad, ventral or palatal bar and a narrower dorsal bar that may have contacted the skull roof. All but the palatal bar may represent the sphenethmoid, and the channels formed on either side of the vertical pillar probably carried the olfactory nerves.

The main, posterior body of the parasphenoid has the form of large, smooth, subrectangular plate that underlies most of the anterior portion of the endochondral braincase. The stout, subcircular, rod-like structure of the basipterygoid processes is continued by the basal or internal processes of the pterygoid, with which it is solidly united by a strongly interdigitating suture to form an immobile union between the braincase and

palate. The foramina for the internal carotids are clearly visible near the midline between the basipterygoid processes. Posterior to the basipterygoid processes the lateral margins of the parasphenoidal plate are angled dorsolaterally to give it a slightly waisted appearance as they form the ventral margin of the fenestra ovalis. The posterolateral corners of the parasphenoidal plate are thickened slightly into a low ridge to form the cristae ventrolaterales, whereas between the cristae the posterior margin of the plate thins to a feathered edge. The basioccipital, which is co-ossified with the exoccipitals, extends well beyond the posterior margin of the parasphenoidal plate and forms, at least in part with the exoccipitals, a distinctly double occipital condyle.

In occipital view the slightly horizontally oval, concave articular surface of each condyle faces posteromedially and slightly ventrally. The exoccipital portions of the complex extend dorsally above the condyles as stout, slightly waisted processes on either side of the foramen magnum, with the basioccipital presumably making a small contribution to the ventral margin of the foramen. Dorsally the exoccipitals do not meet, but contact the occipital flanges of the postparietals, which completed the dorsal margin of the foramen magnum.

The prootic and opisthotic are co-ossified to form a single otic bone, which in *Aspidosaurus binasser* is well exposed only on the left side of the braincase. The lateral surface of the otic bone is dominated by a stout, pillar-like ridge on both the fore and aft margins of the large fenestra ovalis and extends anterodorsally onto the ventral base of the distally incomplete, flat, plate-like paroccipital process. A thin, nearly vertical, anterolaterally directed flange is co-ossified with and occupies the angle between a thickened extension of the anterior surface of the otic bone and the dorsal surface of the basicranial union. Although the dorsal and anterior margins of the flange are incomplete, its dorsal extent suggests a contact with ventral surface of the parietal, whereas anteriorly it may have contacted the transverse portion of the pterygoid. The position and extent of the flange match that described and identified as the epipterygoid by DeMar (1968) and Schoch (1999) in *Dissorophus* and *Kamacops*, respectively. All that remains of the stapes is the expanded footplate and approximately the proximal half of the shaft of the right, which is directed posterolaterally from the fenestra ovalis. There is a gradual narrowing of the footplate to the shaft, followed by gradual but lesser expansion of the dorsal margin of the shaft. At about the neck between the footplate and shaft a foramen for the stapedial artery pierces the posteromedial surface of the stapes.

Lower Jaw.—The lower jaw in *Aspidosaurus binasser* is represented by the right mandible anterior to the adductor fossa, which is tightly joined in its correct position to the skull, whereas all that remains of the left mandible are two large, isolated segments, one including the symphysis and the other from an area anterior to the adductor fossa. Where the sutures are preserved and visible, they do not deviate from the expected dissorophid pattern. Sutures separating the coronoids, of which there were probably three, cannot be discerned, as they are covered by a continuous field of a coarse shagreen of small denticles whose bases are surrounded by an indurate limy matrix. With the exception of two complete teeth, all that remains of the marginal dentition are tooth bases, but the complete teeth duplicate in size and structure those of the upper jaw. The tooth row extends to approximately the level of the midlength of the orbit, but a tooth count is not possible.

Vertebral Column.—The vertebral column is represented primarily by six short strings of from 2 to 5 closely articulated vertebrae, almost all of which lack complete neural spines. Their regional positions within the column cannot be identified beyond the conservative determinations of presacrals and caudals. In addition, there are numerous isolated vertebral elements and fragments, particularly neural spines, presumably from all regions of the column. Judging from this assortment it can be confidently estimated that the presacral
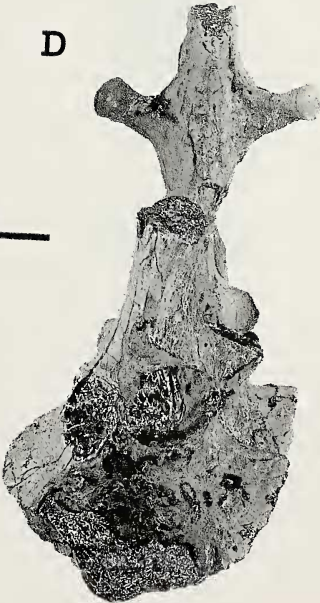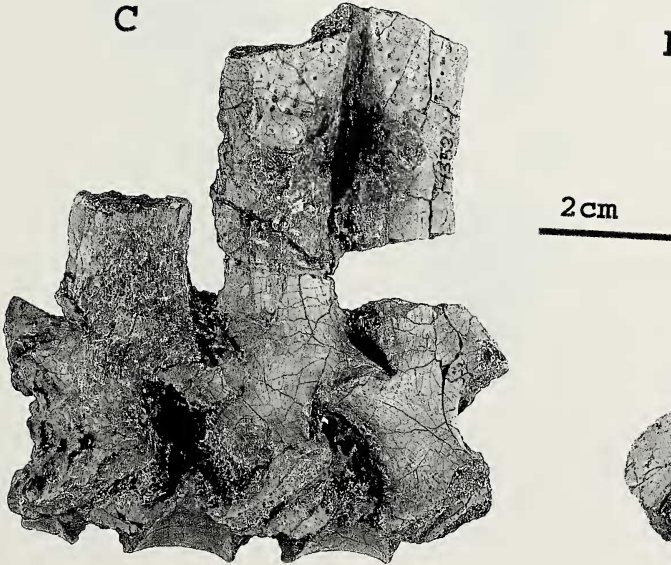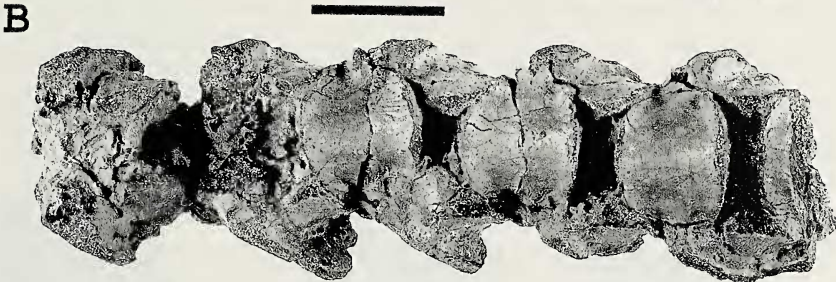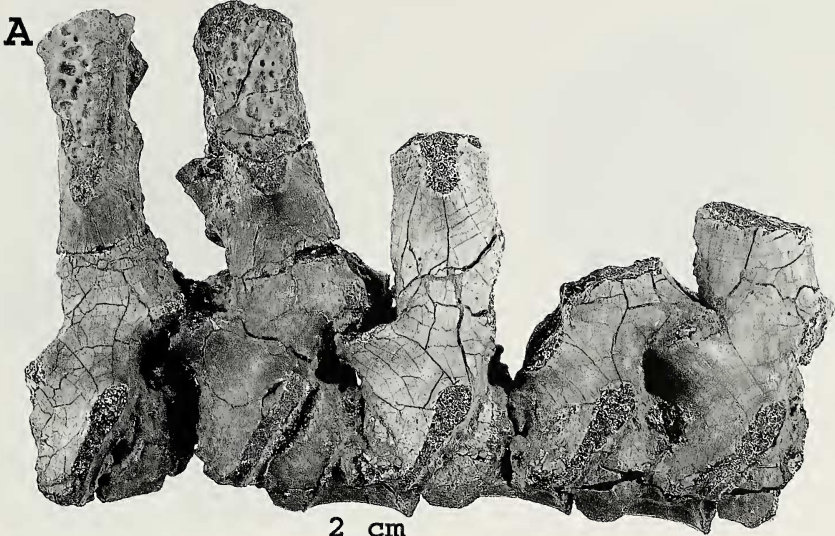
count must have at least slightly exceeded 20. The preserved central elements (Fig. 6), which are of the typical temnospondyl pattern, exhibit no marked or apparent regional differentiation other than size. They are well ossified and fit tightly together, indicating only a very minimum of intervening cartilage. However, mid-ventrally the successive intercentra are well separated from each other by ventromedial expansions of the paired, rhomboidal pleurocentra, which in lateral view appear to nearly reach the ventral margin. These spatial relationships of the central elements may be slightly exaggerated as the result of moderate, dorsoventral compression of the column. Internal ossification of the central elements is also pronounced, so that the notochordal and neural canals are expanded only moderately beyond the limits of the structures they carried. On the lateral surface of the apices of the wedge-shaped intercentrum there is typically a small, rounded, laterally projecting parapophysis. The pleurocentra support the posteroventral margins of the neural arch pedicle while contacting the intercentrum of the next posterior centrum. A short, anteroventrally elongate transverse process projects laterally from very near the entire posteroventral margin of the neural arch pedicle, terminating as the diapophysis. Its distal end is very slightly beveled ventromedially so that the articular surface, which narrows noticeably ventrally, faces laterally and slightly ventrally. The articular planes of the well-developed zygapophyses slope strongly ventromedially.

Dermal armor fused to the distal ends of neural spines is present in all of the preserved neural spines of *A. binasser* that are complete enough to detect its presence. The armored neural spines are remarkable for their wide range in morphology, particularly the dermal-armor portion. To avoid confusion the terms "armored neural spine" or simply "spine" are used here to refer to combined, fused elements of the endochondral neural spine of the neural arch and the sculptured, plate or segment of dermal bone widely referred to as armor. For the convenience of description three types of armored neural spines are recognized: **type 1**, dermal armor roof-shaped and neural spine with prominent, bilaterally paired tubercles (Fig. 6); **type 2**, dermal armor roof-shaped and neural spine lacks lateral tubercles (Fig. 7); and **type 3**, laterally compressed to an extremely thin spatulate-shaped structure and neural spine with prominent, bilaterally paired tubercles (Fig. 8). Type 1 is the most common of the preserved armored neural spines, with a minimum number of examples approximately 35 and, therefore, must have dominated most regions of the column. They are represented in the short, articulated strings of the largest preserved vertebrae that are presumably from the presacral region of the column (Fig. 6), but most occur as isolated, much smaller fragments. In general, the dermal armor segment capping the neural spine is roof-shaped, with each half of the roof sloping steeply ventrolaterally from a keel-like crest whose midline length is equal to or slightly greater than the anteroposterior width of the neural spine summit. The ventrolaterally sloping halves of the roof form a ventral, midsagittal angle between them of about 40°, and each ends ventrally at about the mid-height of the spine in a V-shaped border. The external surface of the dermal cap is strongly sculptured by a reticulate pattern of ridges surrounding deep, irregular pits except for a distinct, smooth area that is finely pitted along the anterior and posterior margins near its summit. In anterior or posterior view the distal portion of the neural spine is expanded

<div align="right">⟶</div>

Fig. 6.—*Aspidosaurus binasser*, holotype, TMM 43531-1. Presumed presacral vertebrae possessing armored neural spines referred to in the text as being of the "type 1" morphology in which the dermal armor is roof-shaped and the neural spine possesses prominent, bilaterally paired tubercles. A, left lateral, and B, ventral views of five incomplete, articulated vertebrae in which only the armored neural spine of the anteriormost vertebra is complete. C, left lateral, and D, anterior views of three incomplete, articulated vertebrae, with the latter view showing the full lateral extent of the paired tubercles of the second element of the series.
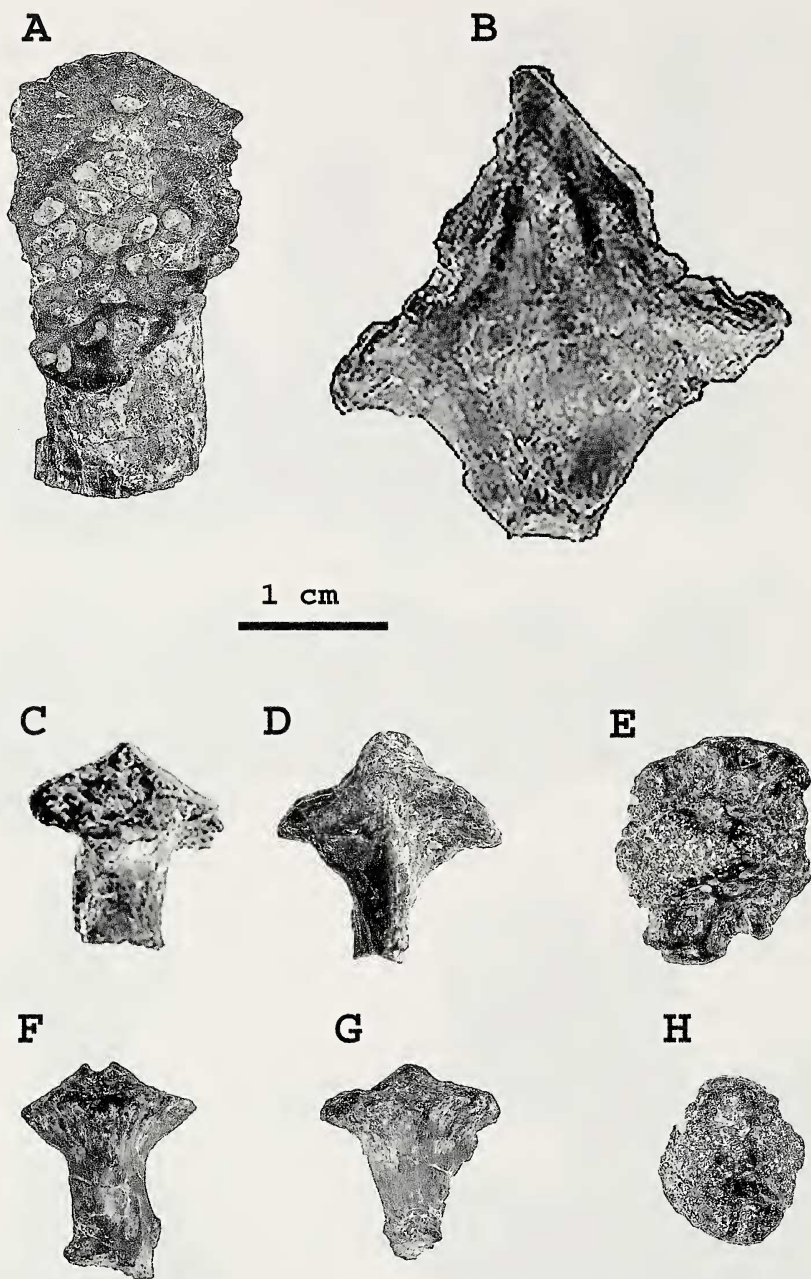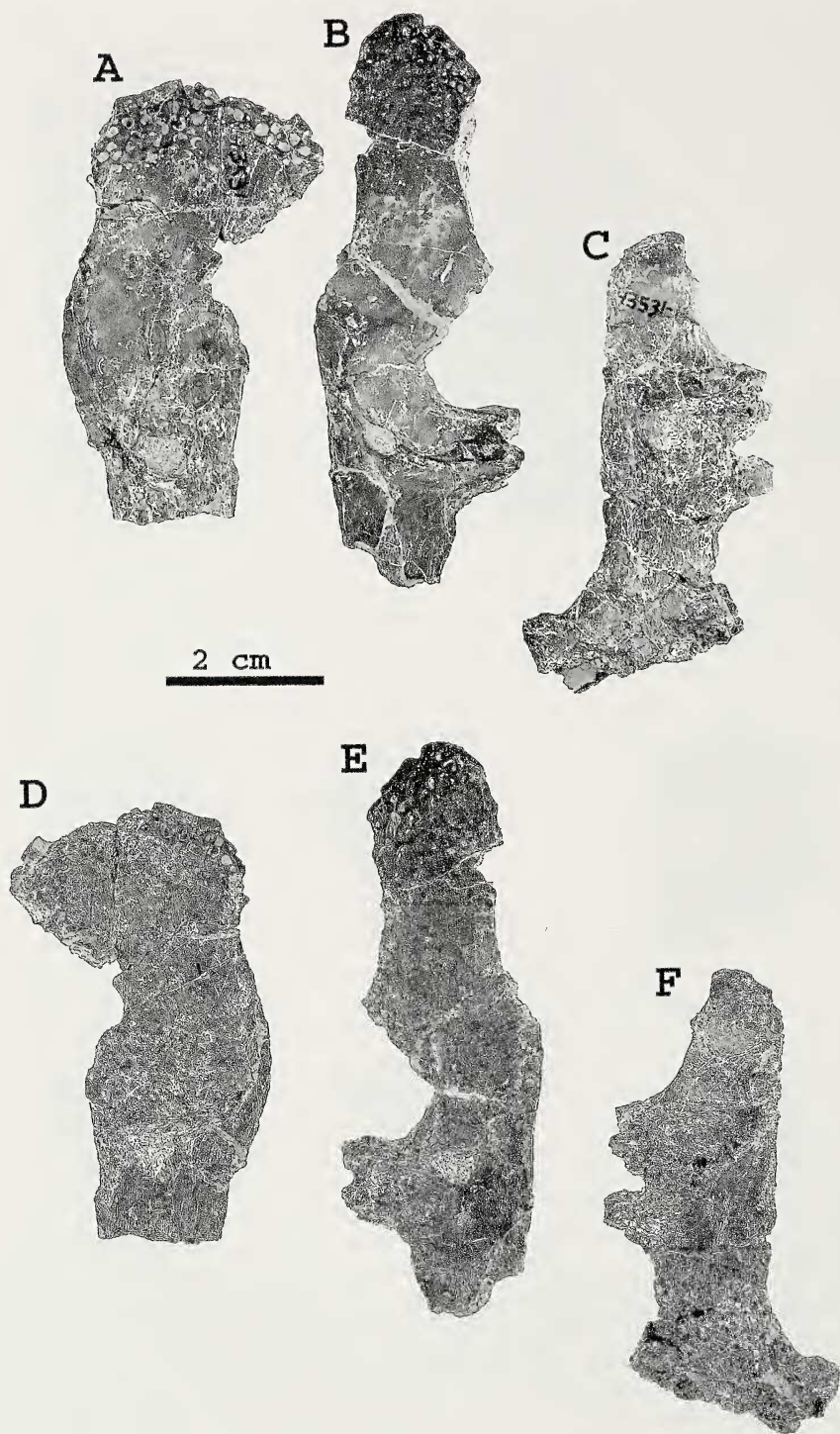
Fig. 7.—*Aspidosaurus binasser*, holotype TMM 43531-1. Armored, vertebral neural spines referred to in the text as being of the "type 2" morphology in which the dermal armor is in general roof-shaped but quite variable in overall structure and the neural spine lacks lateral tubercles. A, lateral, and B, longitudinal views, respectively, of an armored neural spine having the form of a steeply pitched, roof-shaped structure. C and F, D and G, and E and H, lateral, longitudinal, and dorsal views, respectively, of two armored neural spines having the form of a mushroom-like structure.

laterally to fuse with the inner margins of the dermal armor cap, and then narrows to a normal width below the dermal cap so as to have an overall outline of a vertically elongated diamond. In the same views a strongly developed, median ridge at the level of the capping armor is continued ventrally as the edge of the neural spine. On both sides of the neural spine the ventral, V-shaped termination of the dermal armored segment is marked by a strongly developed, laterally projecting, cylindrical tubercle, often broken off, that appears to originate from the neural spine at about its midheight. However, the ventral apex of the sculptured dermal cap is continued onto the dorsal surface of the lateral tubercle. The paired, lateral tubercles of each neural spine are bilaterally positioned, and those of successive neural spines in the articulated examples are aligned along the column so as to occupy a single horizontal plane. The heights of the type 1 armored neural spines appear quite typical compared to other temnospondyls and do not vary noticeably along the column.

Examples of the type 2 armored neural spine (Fig. 7), having generally roof-shaped dermal armor and no obvious development of lateral tubercles, are the least represented, with about 10 examples. All are fragmentary, having been broken off the neural arch above the zygapophysis, and exhibit a considerable range in size and morphology, with the diminutive size of some indicating a far distal position in the tail. In one variant (Fig. 7A, B) the lateral halves of the deeply sculptured roof-shaped dermal cap diverge from one another ventrolaterally in the form of an inverted V, with a midsagittal ventral angle between them of about 70°. The roof-shaped dermal cap sometimes expands a short distance beyond the anterior and posterior margins of the neural spine, giving them a slightly greater length longitudinally relative to their lateral width than in the type 1 spine. However, as in the type 1 spine, the dorsal surface is strongly sculptured except for a smooth, very finely pitted area along the anterior and posterior margins that expands toward the midline crest. Considering the large size of this variant of the type 2 armored neural spine, it could be from either the presacral or the anterior caudal region of the column. In a second, very small variant (Fig. 7C–H) the dermal cap is circular to subcircular in dorsal outline, and its dorsal surface varies from slightly dome-shaped to very slightly roof-shaped, giving it a mushroom-like appearance. Again, the dorsal surface is coarsely sculptured except for a smooth, very finely pitted area along the anterior and posterior margins that expands toward the midline crest.

The laterally compressed, extremely thin, spatulate-shaped type 3 armored neural spines are very distinct from those described above. Of the type 3 spines there are perhaps as many as a dozen examples, mostly fragments, but three (Fig. 8) are represented by all but a small portion of the base of the neural spine. Fortunately, one of the spines (Fig. 8C, F) is complete enough to include most of the zygapophyses, and thus provides clues to the anterior-posterior orientations of the other two examples. Immediately noticeable is that the spines are extremely compressed laterally to form tall, thin blades of variable dimensions, but in general expand gradually distally into a convex distal margin. Clearly, those in Figure 8 suggest a greatest spine height perhaps equaling twice that of the presacral type 1 spines. Their thinness is due apparently in great part to the neural spine only partially penetrating distally between the lateral halves of the dermal cap and not being expanded. The sculpturing of the spine is most accentuated along the distal convex margin. On either side of the spine the lower portion of the sculpturing ends ventrally by its fore and aft margins, both marked by a prominent ridge, converging on a well-developed lateral tubercle that is broken off at the base in all the examples at hand. Again, the paired tubercles are bilaterally positioned and appear to have their origin mainly from the neural pine. At or just above the level of the lateral tubercle the posterior margin of the spine exhibits a deep, smooth, concave embayment, whereas the anterior margin may vary from slightly convex to straight. The ventral margin of the embayment may be extended posteriorly by a stout,

pronounced protuberance that is thickened into a rounded cross-section with a papillose-like lateral sculpturing of smoothly finished bone and a deeply, irregularly pitted posterior surface of unfinished bone. Undoubtedly, this structure served as the site of attachment of a thick band of interspinal ligaments. In the most complete of the type 3 spines, the one that includes the zygapophyses (Fig. 8C, F), there is a second, much smaller, posteriorly projecting process just below the prominent posterior protuberance. Its smoothly rounded ventral margin forms a second, larger, broadly concave embayment before bifurcating to form buttresses to the posterior zygapophyses. In the type 3 spine there are no smooth areas along the anterior and posterior margins of the lateral, sculptured surfaces of the spine, as in the spine types 1 and 2. Instead, the anterior and posterior edges of the spine are typically indented in the form of a narrow, shallow channel of unfinished bone that undoubtedly represents an area of attachment of interspinal ligaments. Compared to the type 1 spines believed to be from the presacral region of the column, in the type 3 spines the bases of the neural spines are much thinner in cross-section and the pre- and postzygapohyses are set much closer to the midline, suggesting that they represent anterior caudals. Furthermore, they are extremely variable size, as might be expected if anterior caudals, which in amphibians typically exhibit a pronounced decrease in size posteriorly.

Associated with some of the articulated vertebral material are ribs with prominent uncinate processes, which is a typical feature of dissorophids.

COMPARISONS AND DISCUSSION

Despite the incompleteness and unavailability for study of the holotype of *Aspidosaurus chiton*, Broili's (1904) description, including figures of the skull and numerous vertebrae, is sufficient to assure the validity of the species and its assignment to Dissorophidae. Although additional specimens of *Aspidosaurus* have since been described, they are based on very small portions of vertebral column. This is unfortunate, as Broili's description of the skull of *A. chiton* was somewhat superficial, and thus eliminates a possible detailed comparison with the holotypic skull of *A. binasser*.

Broili's (1904) description and illustration of the skull of *Aspidosaurus chiton* does reveal, however, several features that are not only present in *A. binasser*, but when considered collectively also provide convincing evidence of dissorophid affinities: 1) skull outline broadly triangular with a broadly rounded snout; 2) large, circular orbits; 3) large external naris with a broad, anteroposterior elongate oval outline; 4) deep, prominent otic notch; 5) thickening of the prefrontal and postorbital bones into broadly rounded, anteroposteriorly oriented, ridge-like swellings that become broader and thicker toward the orbital rim; 6) pit-and-ridge sculpturing strongly accentuated along the margins of the skull table and the postorbital cheek region; 7) ossified denticulated 'skin' covering of the interpterygoid vacuity region of the palate; and 8) marginal teeth small, closely set, sharply pointed, and slightly recurved. Although Broili (1904) did not indicate whether *A. chiton* possessed extremely wide interpterygoid vacuities, which is typical of all dissorophids, including *A. binasser*, it almost certainly would have possessed this feature.

←—

Fig. 8.—*Aspidosaurus binasser*, holotype TMM 43531-1. Armored neural spines of presumed anterior caudal vertebrae referred to in the text as being of the "type 3" morphology in which the dermal armor and neural spine form of a thin, laterally compressed, spatulate-shaped structure and possess paired, bilaterally paired tubercles. A, B, and C, left lateral views and D, E, and F, right lateral views of the same three armored neural spines, respectively. Orientation can be confirmed only in the spine of C and D, as it includes the zygapophyses. The spines are aligned with their lateral tubercles (broken off at their bases except in F) at the same plane.

Most importantly, Broili's (1904) illustration of the skull of *A. chiton* reveals one easily recognizable feature that is shared with *A. binasser* and distinguishes both from all other dissorophids: a greater preorbital length of the skull. Measurements made from Broili's illustration of the skull of *A. chiton* in dorsal view yield the following rough estimates: midline skull length, 8.0 cm; preorbital length, 4.1 cm; postorbital length to the distal end of tabular, 3.0 cm. These measurements indicate a preorbital length that is about 51% of the skull length and significantly greater than the postorbital length. In *A. binasser* the same three skull measurements, 19.5, 10.5, and 7.0 cm, respectively, indicate a preorbital length that is about 54% of the skull length and significantly greater than the postorbital length. The range of available measurements for other dissorophids, on the other hand, indicates a preorbital length that is about 35–45% of the skull length and subequal or, more typically, shorter than the postorbital length (DeMar, 1968; Berman et al., 1981, 1985). A striking feature of *A. binasser* among Lower Permian forms is the large size of its skull (Bolt, 1974). In this feature it is approached only by *Platyhystrix*, with a midline skull length of about 19.0 cm (Berman et al., 1981).

Not being able to make direct comparison with the holotype of *A. chiton* also eliminates the opportunity to determine whether it possessed any of the following cranial features that collectively distinguish *A. binasser* from other dissorophids: 1) possession of an internarial fenestra or median rostral fontanel; 2) dorsal exposure of the palatine on the skull roof; 3) internal naris extremely long, with a length equal to about three times its width; and 4) basipterygoid process of the braincase and the basal process of pterygoid firmly united suturally to produce an immobile basicranial articulation. Similarly, it is unknown whether *A. chiton* possessed any of the following characters that uniquely distinguish *A. binasser* from all other dissorophids: 1) maxilla and its dentition end posteriorly at a level just posterior to anterior orbital margin, rather than extending farther posteriorly to a level at or a short distance beyond the posterior orbital margin; 2) nasal and lacrimal margins of the external naris beveled ventrally to a sharp edge, with the dorsal surface sculpturing giving them a serrated appearance; 3) frontals extend anteriorly to a level well beyond the anterior orbital margins and equal to the anterior extent of the prefrontals. Although the frontals in dissorophids may extend a short distance beyond the level of the orbits, they never reach the level of the anterior extent of the prefrontals; 4) jugal extends anteriorly to approximately the level of the anterior margin of the orbit, rather than ending at about the midlength of the orbit; and 5) presence of an anterior palatal fenestra. Considering the very conservative nature to cranial differentiation displayed between members of the same dissorophid genus, it is likely that most of both sets of the above cranial features would be expected to be present in *A. chiton*.

Although cranial comparisons offer no definitive means for distinguishing between the holotypes of *Aspidosaurus binasser* and *A. chiton*, the vertebrae do. However, this avenue of comparison has been complicated somewhat by the descriptions of three additional species of *Aspidosaurus*, all based on very small, fragmentary, postcranial specimens from Lower Permian deposits in Texas and New Mexico that consist mainly or solely of vertebrae exhibiting the distinctive, structural pattern of the armored neural spines in *A. chiton*: *A. glascocki* Case, 1910, represented only by the holotype (AMNH 4864), consisting of five articulate vertebrae with armor from the Lower Permian Petrolia Formation (ex Belle Plains, Hentz, 1988), Wichita Group, of Texas (Romer, 1928); *A.* (*Zatrachys*) *apicalis* (Cope, 1878), represented only by the holotype (AMNH 4785), consisting of the distal ends of several neural spines with armor from the Lower Permian Abo Formation of New Mexico; and *A.* (*Zatrachys*) *crucifer* (Case, 1903), represented not only by the holotype, a single neural spine with armor (CNHM UC 1205) for which there is no exact stratigraphic or locality data other than Lower Permian of Texas, but also several

specimens of isolated vertebrae with armor assigned to it from various levels in the Lower Permian of Texas (DeMar 1966; Carroll, 1964). Generic reassignment of the latter two species was made by Case (1910), who realized the erroneous association of *Aspidosaurus* vertebrae with cranial material of *Zatrachys*. Case (1911) and DeMar (1966) have presented excellent illustrations and descriptions that succinctly detail the differences between their armored neural spines of all three species, which reasonably explains why the validity of all three taxa has been accepted for so long. It is now evident, however, that the differences between them are not sufficient for species identification, but rather are easily accounted for by the wide range of variation of the armored neural spines in *A. chiton* and *A. binasser*. It should also be noted here that *Aspidosaurus* obviously does not include *A. novomexicanus*, originally described by Williston (1911), and Langston's (1953) reassignment of the species to the dissorophid *Broiliellus* on the basis of referred specimens is widely accepted (DeMar, 1966).

Although the sample size of the armored neural spines available to Broili (1904) in describing *A. chiton* may have been somewhat limited, two or possibly three types can be recognized as essentially duplicating those in other previously described species of *Aspidosaurus*. His generalized reconstruction of two articulated vertebrae with slightly overlapping, roof-shaped armor segments, which he believed may have come from the anterior presacral region or possibly the sacral region of the column, has apparently been widely accepted as typifying the entire column by most (Case, 1911; DeMar, 1966) but not all (Carroll, 1964) later authors. They are not significantly different, however, from those seen in the holotype of *A. glascocki*, which have been described as coarsely sculptured, roof-shaped dermal armor plates firmly fused to the expanded dorsal ends of neural spines that not only overlap each other anteriorly and posteriorly in no particular order, but also appear to be partly fused at their overlapping margins. Also among the armored spines of *A. chiton* illustrated by Broili (1904) are those resembling *A. crucifer*, which are also identical to those described here as type 2 in *A. binasser*. The holotypic armored neural spines of *A. apicalis* (now lost according to DeMar, 1966), which were described (Case, 1911; DeMar, 1966) as coarsely sculptured, flat, oval in dorsal outline, with a median dorsal keel, approach those in *A. crucifer* and described here as a variant of type 2 in *A. binasser*. Considering the above similarities and the wide range of variation in the armored spines in *A. chiton* and especially *A. binasser*, the very fragmentary holotypes on which *A. glascocki*, *A. apicalis*, and *A. crucifer* are based must be considered as an insufficient grounds for specific identification, and so the three species are regarded here as *nomina dubia*. On the other hand, the occurrence of neural spines with overlapping dermal armor in *A. chiton* but not in *A. binasser*, and the absence in *A. chiton* of armored spines that in *A. binasser* are described here as types 1 (dermal armor roof-shaped and neural spine with prominent, bilaterally paired tubercles) and 3 (laterally compressed to extremely thin, spatulate-shaped structure and neural spine with prominent, bilaterally paired tubercles) provides a firm basis for recognizing both species as valid. It is also worth noting that despite specific differences in their armored neural spines, the holotype of *A. binasser* confirms the association of the skull and vertebrae attributed by Broili (1904) to *A. chiton*.

It has been suggested (DeMar, 1966) that the finely pitted, smooth areas bordering the anterior and posterior margins on the dorsal surface of the otherwise coarsely sculptured dermal armor in *Aspidosaurus* may indicate an area of overlap by a second, more superficial segmental series of dermal ossifications, termed the "external series" by DeMar (1966), which did not contact the vertebral column, but rather alternated with the series capping the neural spines. However, among all of the vertebral material at hand there are no dermal armor segments that could be interpreted as representing this second, external series of segmental armor. In light of this, a more reasonable interpretation of these smooth, finely

pitted areas bordering the anterior and posterior margins of the dermal armor is that they represent areas of attachment of interspinal ligaments that functioned to strengthen the vertebral column. In none of the vertebral central materials of *Aspidosaurus binasser* that might be interpreted as caudals is there evidence of fusion, as has been reported (DeMar, 1968) in the dissorophid *Dissorophus multicinctus*.

In describing the wide range of variation of the armored spines in *Aspidosaurus*, DeMar (1966) and Carroll (1964) believed that some exhibited an overlap in morphology with the type represented by the Early Permian *Platyhystrix*. Considering the unique, bizarre, armored neural spines in *Platyhystrix*, as well as those of the rare, very closely related Pennsylvanian *Astreptorhachis*, whose spines are like those in *Platyhystrix* except for fusion between consecutive neural arches and spines (Vaughn, 1971), the likelihood of confusion seems very improbable, but it has occurred. The armored neural spines of *Platyhystrix* are greatly elongated, strongly compressed laterally, and expanded gradually distally in the sagittal plane, and except for a short proximal portion, they exhibit a presumed dermal covering of exuberant, nodular sculpturing. Furthermore, as pointed out by Vaughn (1971), the sculpturing of the armor in *Aspidosaurus* tends to form anastomosing ridges separated by large, deep pits, whereas that in *Platyhystrix* differs in having large tubercle-like protuberances that tend to be separate. Furthermore, an articulated series of *Platyhystrix* presacral vertebrae illustrated by Lewis and Vaughn (1965) showed clearly that in lateral view the spines formed a greatly expanded, sail-like structure with a strongly convex dorsal edge that is somewhat analogous to that in some pelycosaurian-grade synapsids. DeMar's (1966) precautionary statement of possible confusion between the two genera was based on a single specimen (MCZ 1258) of *Aspidosaurus* that consisted of several articulated neural spines with dermal armor assigned to *A. crucifer*. Of the four armored neural spines described and illustrated by DeMar (1966; fig. 7), two conformed exactly to the *Aspidosaurus* pattern, but he believed two approached the pattern of *Platyhystrix* in exhibiting a greater dorsal extension of the armored portion of the neural spine and with little lateral expansion, and in one of these the armor extended a short distance posterior to the neural spine with a continuation of the sculpturing on its posterior margin. By way of comparison with *A. binasser*, this is a minor deviation at best and should not be confused with the very distinct pattern in *Platyhystrix*. As a second example of confusion, Carroll (1964; pl. 1) illustrated eight, isolated armored neural spines (MCZ 1477) from the Lower Permian of Texas that he believed aptly demonstrated a transition in form between those observed in *A. chiton* and *Platyhystrix*. It is now clear that two of these, the long-spines examples on the left and right margins of his plate 1, belong to *Platyhystrix*, whereas three of the six shorter-spined examples are of the *Aspidosaurus* "crucifer" type, and all that can be said of the remaining three is that they belong to *Aspidosaurus*.

It is worth emphasizing that the presacral vertebrae of *A. binasser* were of moderate, subequal height and did not form a sail-like structure as in *Platyhystrix*. However, the spatulate-shaped, type 3 spines believed to be possibly from the caudal region in *A. binasser* are not only slight higher than those of the presacral region, but also are variable in height, suggesting the possibility of a moderate-sized, sail-like structure in the anterior region of the tail. It is also likely that the presacral column in *A. binasser* contained more vertebral segments than in *Platyhystrix*. It is roughly estimated that the presacral portion of the column in *A. binasser* contained 20 or more vertebrae, which is in line with temnospondyls in general and counts 21 to 25 in other dissorophids (Carroll, 1964; DeMar, 1968), but is in marked contrast to an estimated count of 15 or fewer in *Platyhystrix* (Lewis and Vaughn, 1965).

The supposed similarity between the vertebrae of *Aspidosaurus* and *Platyhystrix* has prompted speculations that they were closely related and perhaps formed a distinct lineage

within the Dissorophidae. In a phylogeny of the Dissorophidae, Carroll (1964) showed *Platyhystrix* as an offshoot of the *Aspidosaurus* assemblage, and, furthermore, suggested that the *Aspidosaurus-Platyhystrix* assemblage separated from the remainder of the dissorophids late in the Pennsylvanian or in the Early Permian. On the basis of similar structural patterns of the armored neural spines in Dissorophidae, DeMar (1966) recognized two major groupings, the Dissorophinae that includes *Dissorophus* and *Broiliellus* and the Aspidosaurinae that includes *Cacops*, *Aspidosaurus* and *Alegeinosaurus*. The description of *Aspidosaurus binasser* has provided for the first time details of the skull of a member of that genus and the opportunity to compare it with the single description (Berman et al., 1981) of the skull in *Platyhystrix*. Without enumerating numerous structural and proportional differences, the comparison would seem to dispel any speculation of a close relationship between *Aspidosaurus* and *Platyhystrix*.

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